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Development of highly granular hadronic calorimetry with glass scintillator tiles

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Future electron-positron colliders (e.g. the Circular Electron Positron Colllider, namely CEPC) impose stringent requirements on the energy resolutions of hadron and jets for the precision physic programs of the Higgs, Z, W bosons and the top quark. To address the challenges, one of the state-of-art calorimetry options is high-granularity calorimetry based on the particle flow algorithms (PFA). The CEPC team has proposed a new detector concept named “the 4th detector concept”. A major motivation is to significantly improve the Boson Mass Resolution (BMR) of better than 3% compared to 4%, which corresponds to the performance of the baseline detector proposed in the CEPC Conceptual Design Report (CEPC CDR).
As a key sub-detector in “the CEPC 4th detector concept”, a new design of highly granular sampling hadronic calorimetry (HCAL) has been proposed, which consists of sensitive layers with glass scintillator tiles and absorber plates. A major motivations is to significantly improve the hadronic energy resolution with a higher energy sampling fraction and a significantly lower energy threshold, which in turn requires the merits of high density and high light yield for the glass scintillator materials. A simulation model with Geant4 has been developed for the design optimizations of the glass scintillator HCAL and quantitative hadronic performance with single hadrons. Furthermore, physics potentials of the PFA performance have also been evaluated in the CEPC full detector simulation. Highlights of the expected hadronic performance and hardware developments will be presented in this contribution. Future beamtest preparations of a few glass scintillator tiles are currently ongoing and preliminary results could be expected as well.

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